

APPLICATION UNDER UNITED STATES PATENT LAWS

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Invention: Arrangement For The Cooling Of The Casing Of An Aircraft Gas Turbine Engine

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This is a:

- ☐ Provisional Application
- ☒ Regular Utility Application
- ☐ Continuing Application
 _____ The contents of the parent are
 incorporated by reference
- ☐ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application

SPECIFICATION

Specification

This application claims priority to German Patent Application No 10042933.5, filed August 31, 2000, the contents of which are incorporated by reference herein.

This invention relates to an arrangement for the cooling of the casing of an aircraft gas turbine. More particularly, this invention relates to an arrangement for the cooling of the casing of an aircraft gas turbine with a bypass duct and at least one cooling air tube, this cooling air tube having its inlet arranged in the bypass duct and entering at least one cooling air chamber for the supply of cooling air to the casing.

In the prior art, a large one-stage fan is provided on bypass gas turbine engines which delivers one portion of the air flow through the core engine and another portion, the bypass, through a closed annular duct (bypass duct). For the purpose of clearance control on a high-pressure turbine or a low-pressure turbine, means are known in the state of the art which provide for appropriate cooling of the casings, thereby minimizing the tip clearances and avoiding flow losses at the blade tips.

To enable the cooling of the casing, i.e. the tip clearance, to be adapted to the prevailing operating conditions of the engine, suitable means must be provided for the control of the cooling air flow. In particular with engine designs in which the cooling air flow is driven by only the dynamic pressure in the bypass duct, the implementation of appropriate means for the control of the cooling air flow may incur a considerable technical investment. The control of flow in the bypass duct itself would necessitate relatively large control elements or valves which would impair the flow-through and the efficiency of the bypass duct.

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In a broad aspect, the present invention provides an arrangement of the type specified at the beginning which combines simplicity of design, cost-effective manufacture as well as simplicity and safety of operation with the capability of controlled cooling of the casing of a turbine.

It is a particular object of the present invention to provide a gas turbine having a cooling air tube having an inlet in an air bypass duct and an outlet connected to a cooling air chamber for supplying cooling air from the air bypass duct to a casing of the turbine, with an air deflector positioned in the bypass duct upstream of the cooling air tube inlet, the air deflector being movable to deflect air from the cooling air tube inlet. Further objects and advantages of the invention will be apparent from the description below.

In accordance with the present invention, a movable air deflector is provided in the bypass duct upstream of the inlet of the cooling air tube.

The present invention is characterized by a variety of merits.

Installing an air deflector upstream of the inlet of the cooling air tube enables the air flow in the bypass duct to be influenced to the effect that it either enters the cooling air tube without disturbance or that it is either completely or partly passed by the inlet of the cooling air tube. The air deflector in accordance with the present invention is very easily implementable and will impair the flow in the bypass duct only insignificantly. This arrangement provides an effective means for controlling the inflow of cooling air into the cooling air tube.

In accordance with the present invention, the air deflector influences the effective inlet area of the cooling air tube. This will control the inflow of the cooling air into the cooling air tube and, consequently, the cooling effect applied to the casing of the turbine.

In a particularly favorable development of the present invention, the air deflector is movable between an open position in which the inlet of the cooling air tube is completely exposed to the air flow, and a closed position in which the inlet of the cooling air tube is isolated from the air flow. This arrangement enables the effective inlet area of the cooling air tube to be varied infinitely.

The air deflector is preferably designed as a flap which is movably supported at its forward end. This design provides for appropriate mechanical location of the forward, upstream end of the flap-type deflector. Owing to the shape of the air deflector, the pressure forces exerted by the cooling air flow in the bypass duct will essentially be confined to the air deflector. In a particularly favorable arrangement, the air deflector extends essentially in the direction of the air flow in the bypass duct, enabling the air deflector to make an acute angle between its closed and its open position. The rearward end of the air deflector is preferably located near the inlet of the cooling air tube to avoid undesired swirl or similar effects.

Obviously, the air deflector may have a plurality of geometrical shapes; it may be plate-shaped or spherically curved to optimally match with the inlet section of the cooling air tube.

In a further advantageous arrangement, the air deflector is flat against the inner wall of the bypass duct when it is in the open position. For this purpose, the inner wall of the bypass duct may be recessed to partly or fully contain the air deflector, thereby optimizing it aerodynamically.

The air deflector is preferably set by an actuating rod which is connected to an actuating unit. The actuating unit may be a positioning motor. This provides for a very simple and effective means for swiveling the air deflector.

The invention is more fully described in the light of the accompanying drawing showing an embodiment of the present invention. On the drawing:

Fig. 1 is a simplified section of a partial area of an aircraft gas turbine showing a simplified representation of a combustion chamber, a high-pressure turbine and a low-pressure turbine as well as the cooling air tube and the air deflector in accordance with the present invention.

Fig. 1 illustrates a partial area of an aircraft gas turbine engine in longitudinal section. The aircraft gas turbine engine comprises a combustion chamber 10, a downstream high-pressure turbine 11 and a low-pressure turbine 12. The turbines 11 and 12 are located within a casing 1 which is embraced by an essentially annular cooling air chamber 5. Entering the cooling air chamber 5 is a cooling air tube 3 whose inlet 4 is arranged within a bypass duct 2 into which the bypass air is delivered by a fan, as indicated by the arrowhead 13. Accordingly, the bypass air entering the inlet 4 is ducted via the cooling air tube 3 into the cooling air chamber 5. The cooling air chamber 5 may be divided into individual sub-chambers to ensure that the casing 1 of the turbine is cooled by the cooling air to best effect.

In accordance with the present invention, an air deflector 6 is pivotally located upstream of the inlet 4 of the cooling air tube 3. The upstream end of the air

deflector 6 is located on the inner wall 7 of the bypass duct 2 by means of a hinge 14. Furthermore, an actuating rod 8 is linked to the air deflector 6, this actuating rod 8 being connected to an actuating unit 9 (positioning motor or similar device).

Fig. 1 shows the closed position of the air deflector 6 in which the inlet 4 of the cooling air tube 3 is essentially isolated from the airflow. The lower, open position of the air deflector 6 in which the inlet 4 is fully exposed to the air flow in the bypass duct 2 is indicated by reference numeral 6'. The inner wall 7 may be recessed to contain the air deflector 6 in its open position at least partly, thereby reducing the flow resistance.

Generally, a plurality of modifications may be made to the embodiment shown without departing from the inventive concept expressed.

Summarizing, then, the present invention relates to an arrangement for the cooling of the casing 1 of an aircraft gas turbine with a bypass duct 2 and at least one cooling air tube 3, whose inlet 4 is arranged within the bypass duct 2 and which enters at least one cooling air chamber 5 for the supply of cooling air to the casing 1, characterized in that a movable air deflector 6 is arranged in the bypass duct 2 upstream of the inlet 4 of the cooling air tube 3.

List of reference numerals

- 1 Casing
- 2 Bypass duct
- 3 Cooling air tube
- 4 Inlet of 3
- 5 Cooling air chamber
- 6 Air deflector
- 7 Inner wall of 2
- 8 Actuating rod
- 9 Actuating unit
- 10 Combustion chamber
- 11 High-pressure turbine
- 12 Low-pressure turbine
- 13 Bypass air flow
- 14 Hinge